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Micro-chemical and Micro-Mineralogical Techniques for Sclerochronological Studies – Which One Should I Choose?

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Our multi-institute research group have been using micro-chemical and micro-mineralogical techniques as investigative tools for sclerochronological studies of shells, statoliths and fish otoliths for more than two decades. The primary technique used, has been point analysis by laser ablation-ICP-MS. This provided spatial trace element concentrations and Sr isotopic data on several hundred points per day, typically at 20-50 micron resolution. Considerable valuable information has been gained, but has been limited due to the small fraction of the total area of a shell measured or insufficient fine-scale resolution for chemical banding in small structures, such as statoliths. Our more recent investigations have therefore made use of the ion-probe for precise small spot analysis (2 micron) and synchrotron micro-XRF to map Sr concentrations on a similar scale. The synchrotron can also provide mineralogical information on which calcium carbonate polymorphs exist, using micro-XRD and molecular structural information via XANES and EXAFS. With access to a synchrotron very limited, we have also tested Raman spectroscopy as an alternative for providing mineralogical information. Laser ablation as a technique has not stood still, with recent advances in the laser ablation systems coupled with increasingly sensitive ICP-MS is revolutionizing trace element mapping in terms of data acquisition speed. This presentation will briefly explore and review, using examples, what each technique has to offer the sclerochronologist and what are their advantages and limitations. With the aim of helping others to best choose from this menu of techniques for their own applications.

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